

ADVENTURES
INSIDE THE

ATOM



ADVENTURE SERIES

Produced for
GENERAL ELECTRIC COMPANY
By GENERAL COMICS, Inc.

ALL ENERGY HAS ALWAYS COME FROM "OUT OF THIS WORLD." THE FAR-OFF SUN HAS GIVEN US INDIRECTLY THE **STORED** ENERGY OF COAL AND OIL...THE **LIVING** ENERGY OF PLANTS AND ANIMALS (AND OF HUMANS, TOO).

TODAY, SCIENTISTS HAVE FOUND THE SOURCE OF THE SUN'S STRANGE AND WONDERFUL ENERGY LOCKED IN THE HEART OF THE ATOM... ARE RE-LEASING THAT ATOMIC ENERGY TO SERVE US ALL IN THE FUTURE AS A SOURCE OF ALMOST UNLIMITED POWER.

HERE IS THE THRILLING STORY OF MAN'S GREATEST ADVENTURE INTO THE UNKNOWN... AND HIS DISCOVERY OF NATURE'S GREATEST SECRET.

THE STORY OF NUCLEAR ENERGY



"THE MODERN MIRACLE OF ATOMIC POWER IS THE CLIMAX OF A NEVER-ENDING SEARCH FOR KNOWLEDGE. IT ALL BEGAN MORE THAN 2,000 YEARS AGO IN ANCIENT GREECE..."



"YOU ARE A FOOL, DEMOCRITUS! ALL MEN KNOW THAT THIS GOLD IS ONE SOLID PIECE!"

"NO, I BELIEVE THAT EVERYTHING IS MADE UP OF TINY PARTICLES WE CANNOT SEE."

"MIND NOT THOSE DOUBTERS, MASTER—TELL ME MORE."

"ALL THINGS AROUND US—TREES AND STONES AND EVEN OUR OWN BODIES—ARE MADE OF 'BUILDING BLOCKS' SMALLER THAN ANYTHING YOU CAN IMAGINE. I CALL THEM 'ATOMS.'"



"AND A FEW YEARS LATER, ARISTOTLE ADDED AN IDEA OF HIS OWN..."

"IT MUST BE THAT ALL THE THOUSANDS OF THINGS ON EARTH ARE COMBINATIONS OF CERTAIN BASIC 'ELEMENTS.'"



"FOR CENTURIES AFTER THAT, MEN CALLED 'ALCHEMISTS' STRUGGLED TO FIND THE COMBINATION OF ELEMENTS WHICH WOULD MAKE PRECIOUS GOLD..."



"MAKE ME GOLD, WISE MAN, AND I WILL GIVE YOU A KINGDOM!"

"WATCH AS I STIR THIS SECRET MIXTURE, SIRE!"

"TAKE THAT FOR WASTING THE KING'S TIME"



"AND EVERY MIXTURE FAILED TO MAKE GOLD... BUT ALCHEMISTS KEPT ON TRYING UNTIL..."

"IN 1808, A QUAKER SCHOOL TEACHER, JOHN DALTON, SUGGESTED..."



WITH ALL OUR KNOWLEDGE OF CHEMISTRY, WE CANNOT CHANGE THE ATOMS OF OTHER ELEMENTS INTO GOLD BECAUSE...

GOLD IS ITSELF A BASIC ELEMENT... THE ATOMS OF EACH ELEMENT ARE DIFFERENT FROM THE ATOMS OF ALL OTHER ELEMENTS.



"BETWEEN 1850 AND 1900, SCIENTISTS TRIED TO 'EXPLORE' INSIDE THE ATOM..."



PERHAPS THE ATOM, WHICH WE HAVE THOUGHT THE SMALLEST POSSIBLE PARTICLE, IS ITSELF MADE UP OF PARTS.

...AND THESE PARTS ARE HELD TOGETHER BY ELECTRICAL ATTRACTION.

BUT THERE MUST BE SPACES BETWEEN THESE PARTS INSIDE THE ATOM.

"AND IN 1913, A DANISH SCIENTIST, NAMED NIELS BOHR, COMBINED THESE THEORIES INTO..."

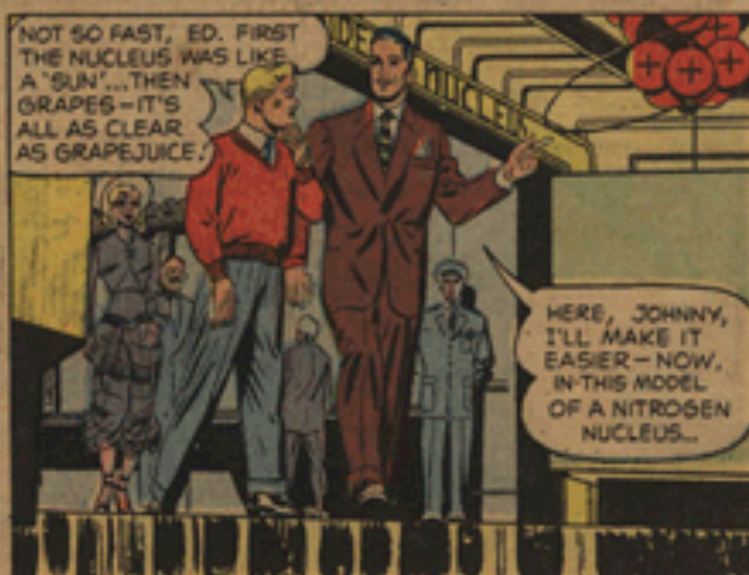
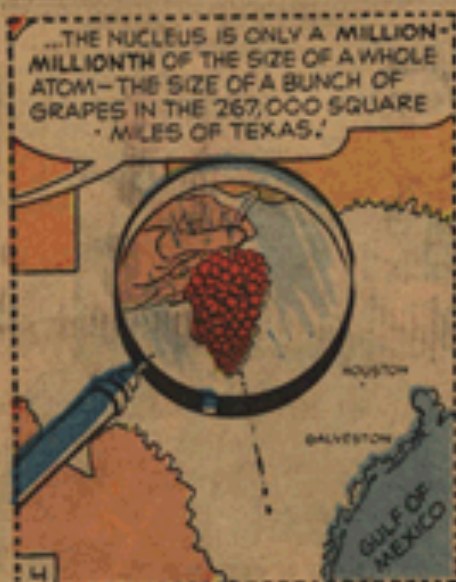
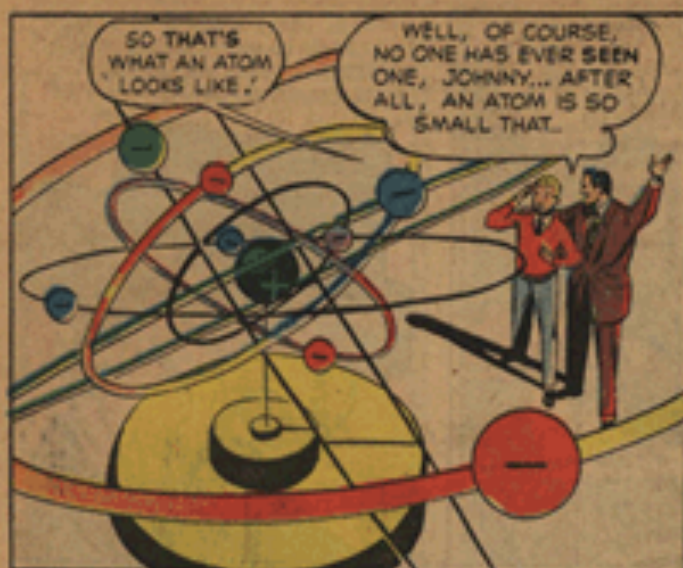


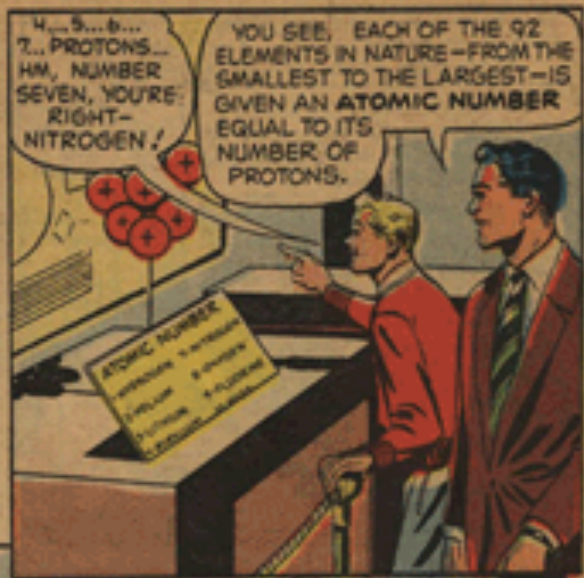
WHY, DR. BOHR, IT'S LIKE A 'SOLAR SYSTEM' WITHIN EACH TINY ATOM, ELECTRON 'PLANETS' WHIRLING AROUND A NUCLEUS 'SUN'...

GOSH, ED, YOU SURE MAKE ALL THAT HISTORY SEEM REAL.

THESE PICTURES AT THIS EXHIBIT HELPED. NOW YOU KNOW WE'VE BEEN WORKING ON THE ATOM FOR A LONG TIME.







"SEE... AN 'ATOM'S NUMBER' IS THE NUMBER OF PROTONS, AND AN 'ATOM'S WEIGHT' IS THE NUMBER OF PROTONS AND NEUTRONS."

TYPICAL ATOMS

NO.	ELEMENT	PRO- TONS	NEU- TRONS	WT.
8	OXYGEN	8	8	16
26	IRON	26	30	56
79	GOLD	79	118	197
92	URANIUM	92	146	238

"YOU MEAN THAT, IF I TOOK OUT SOME OF THOSE PLUSSES, IT WOULD CHANGE THE ATOM TO ANOTHER KIND—THAT'S EASY!"



"BUT, STRANGELY ENOUGH, SOME ELEMENTS CHANGE BY THEMSELVES... ANTOINE HENRI BECQUEREL FOUND ONE IN 1896..."

MADAME CURIE, I CAN'T UNDERSTAND IT... THIS URANIUM ORE GIVES OFF SOME STRANGE KIND OF 'RAY'.

PLEASE, PROFESSOR, LET ME EXPERIMENT WITH IT.



BETWEEN THE TWO OF THEM, THEY DISCOVERED THAT CERTAIN ELEMENTS ARE 'RADIO-ACTIVE'... THAT IS THEY SHOOT OFF SOME OF THEIR PROTONS. HERE, I'LL SHOW YOU.



I GET IT- IT'S SHOOTING OFF PLUS CHARGES.

EXACTLY. LET'S SUPPOSE THIS SPARKLER IS RADIOACTIVE, OR 'HOT,' URANIUM. YOU SEE 92 URANIUM LOSES PLUS CHARGES UNTIL IT BECOMES 88 RADIUM AND...

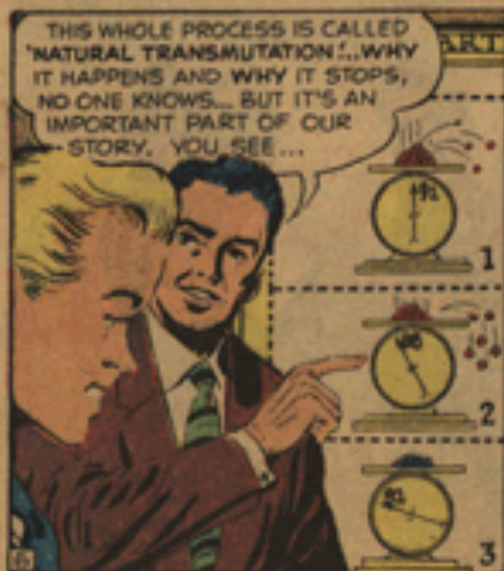


OH-OH... THE SPARKLER STOPPED BURNING.

YES...AND, AFTER CENTURIES, RADIOACTIVE ELEMENTS 'BURN OUT' TOO. EACH 88 RADIUM NUCLEUS LOSES PLUS CHARGES UNTIL IT FINALLY HAS BECOME 82 LEAD, A STABLE, OR 'COLD,' ELEMENT.



THIS WHOLE PROCESS IS CALLED 'NATURAL TRANSMUTATION'... WHY IT HAPPENS AND WHY IT STOPS, NO ONE KNOWS... BUT IT'S AN IMPORTANT PART OF OUR STORY, YOU SEE...

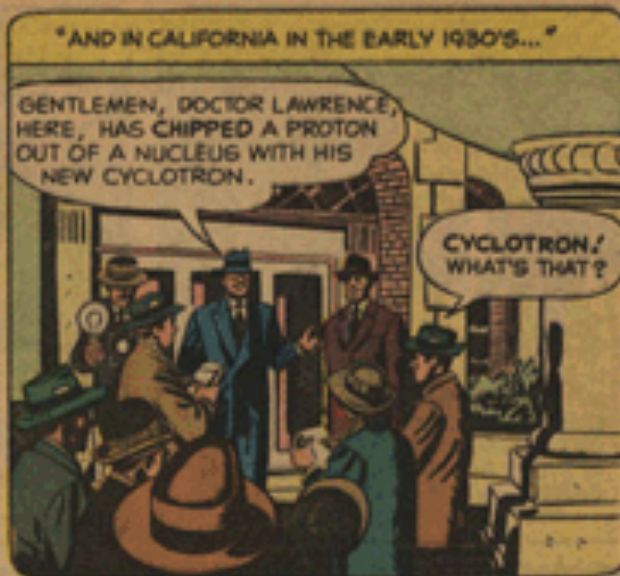
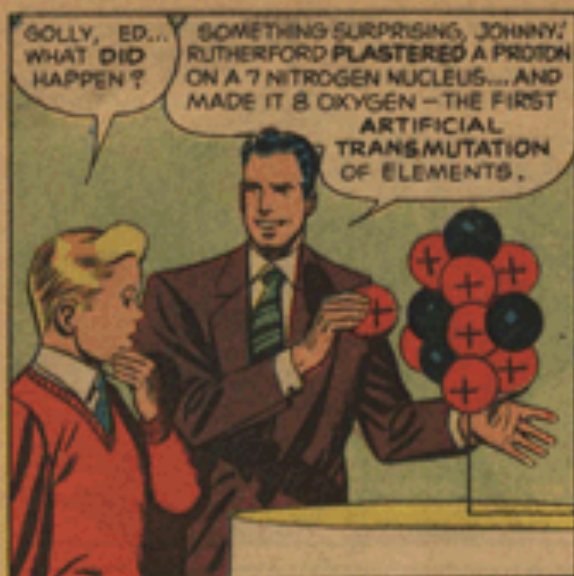


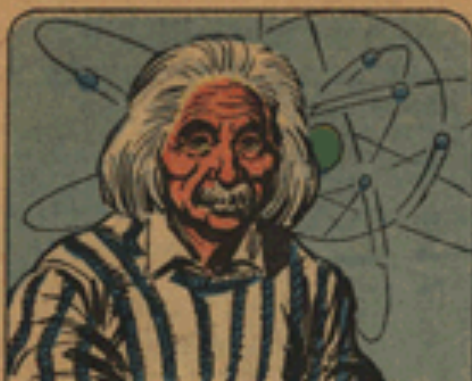
"AN ENGLISH SCIENTIST, SIR ERNEST RUTHERFORD, FOUND AN IMPORTANT USE FOR RADIOACTIVE ELEMENTS IN 1919..."

YOU MEAN SIR ERNEST, THAT YOU CAN USE THE PARTICLES COMING FROM THE RADIUM?

YES...THEY ARE MY 'BULLETS' WHICH I USE TO BOMBARD OTHER ATOMS. YOU NEVER CAN TELL WHAT WILL HAPPEN NEXT.







MEN HAVE ALWAYS USED ENERGY THAT CAME INDIRECTLY FROM THE SUN... BUT IN 1905 ALBERT EINSTEIN SAW, IN EVERY SPECK OF DUST HERE ON EARTH, A POSSIBLE SOURCE OF THAT SAME ENERGY...



'IF MATTER COULD BE DESTROYED ENERGY WOULD BE CREATED IN ITS PLACE'...WHAT NONSENSE...ALBERT WRITES.'

WHY NONSENSE? ISN'T THAT WHAT HAPPENS WHEN I BURN THIS MATCH?



OF COURSE NOT! THAT'S ONLY A CHEMICAL REACTION. ACCORDING TO THIS FORMULA OF EINSTEIN'S... 'ENERGY EQUALS MASS TIMES THE SPEED OF LIGHT SQUARED'.....

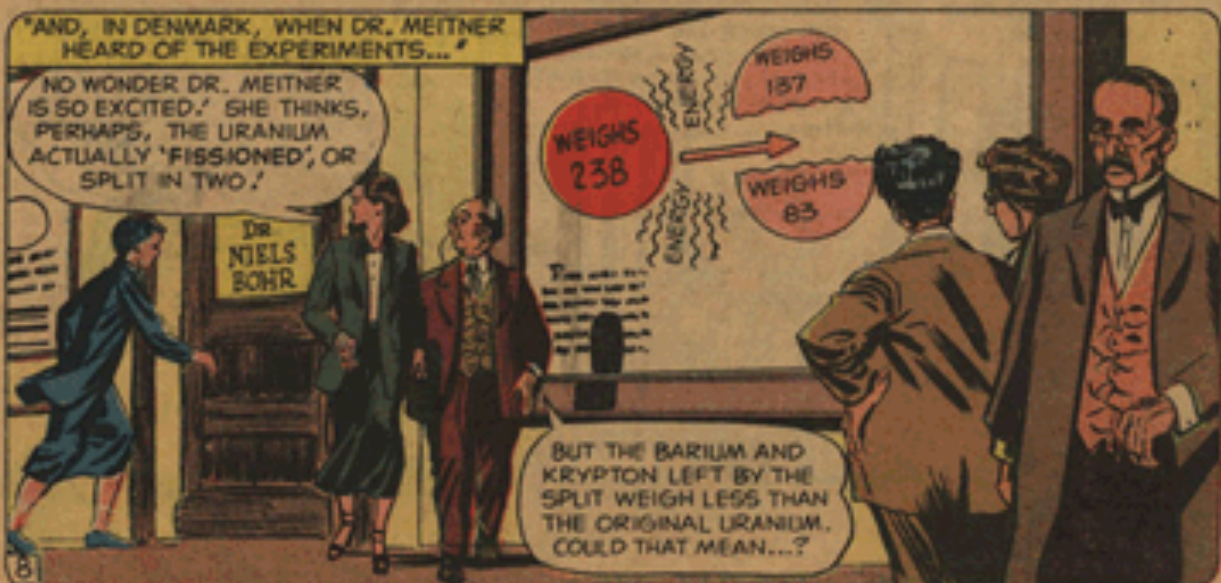
...DESTROYING COMPLETELY THE ATOMS OF THIS MATCH-STICK WOULD MELT ALL THE SNOW IN SWITZERLAND!



'BUT, LUCKILY, SOME SCIENTISTS DID NOT LAUGH AND, FOR 33 YEARS, THEY TRIED TO DESTROY MATTER AND RELEASE ENERGY. IN 1938, WHILE OTTO HAHN AND FRITZ STRASSMAN WERE TRYING TO PLASTER PROTONS ON THE NUCLEUS OF 92 URANIUM....'

WELL, DOCTOR, WE FAILED AGAIN. AND HOW DID THIS 56 BARIUM GET IN WITH THE URANIUM?

STRANGE, HERR STRASSMAN, VERY STRANGE... I WISH DR. MEITNER WERE STILL HERE WORKING WITH US.



'AND, IN DENMARK, WHEN DR. MEITNER HEARD OF THE EXPERIMENTS...'

NO WONDER DR. MEITNER IS SO EXCITED! SHE THINKS, PERHAPS, THE URANIUM ACTUALLY 'FISSIONED', OR SPLIT IN TWO!

DR. NIELS BOHR



BUT THE BARIUM AND KRYPTON LEFT BY THE SPLIT WEIGH LESS THAN THE ORIGINAL URANIUM. COULD THAT MEAN...?

"WORKING ON LISE MEITNER'S CLUE, NIELS BOHR ORGANIZED FURTHER EXPERIMENTS BEFORE LEAVING FOR AMERICA AND, SOON AFTER, AT GEORGE WASHINGTON UNIVERSITY..."

DR. BOHR HAS JUST HEARD THAT THERE IS NOW PROOF THAT THE SPLITTING URANIUM DESTROYED MASS, AND...

ENERGY MUST HAVE BEEN RELEASED! WE MUST CHECK FURTHER!

EINSTEIN WAS RIGHT! COME...LET'S TRY IT IN OUR OWN LAB!

IN THE MANY EXPERIMENTS THAT FOLLOWED, SCIENTISTS IN AMERICA DISCOVERED THAT, STRANGELY ENOUGH, ONLY A CERTAIN KIND OF URANIUM SPLIT.

KIND OF URANIUM? DIDN'T YOU TELL ME ALL URANIUM WAS THE SAME - WITH 92 PROTONS?

ISOTOPES

"YES, JOHNNY, BUT-FOR SOME UNKNOWN REASON-ABOUT ONE OUT OF EVERY 140 COMMON URANIUM ATOMS HAS THREE LESS NEUTRONS. INSTEAD OF WEIGHING 238 AS MOST OF THEM DO, IT WEIGHS ONLY 235." U235 IS THE ONLY KIND THAT SPLITS!"

"COMMON URANIUM
92 PROTONS
146 NEUTRONS
238 WEIGHT"

U238



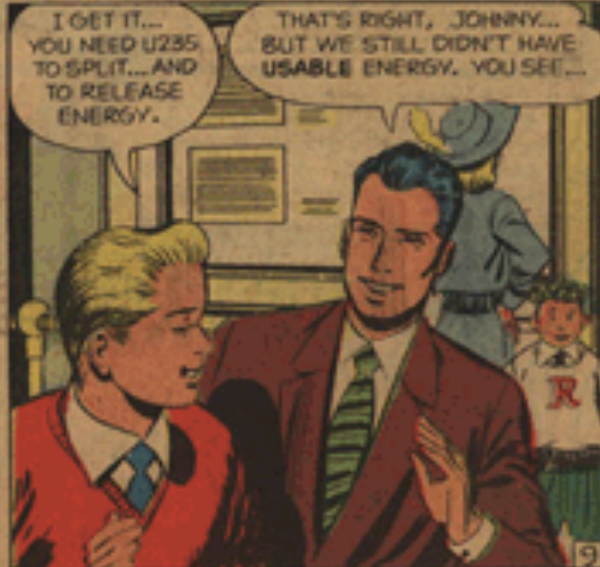
"RARE URANIUM ATOM
92 PROTONS
143 NEUTRONS
235 WEIGHT"

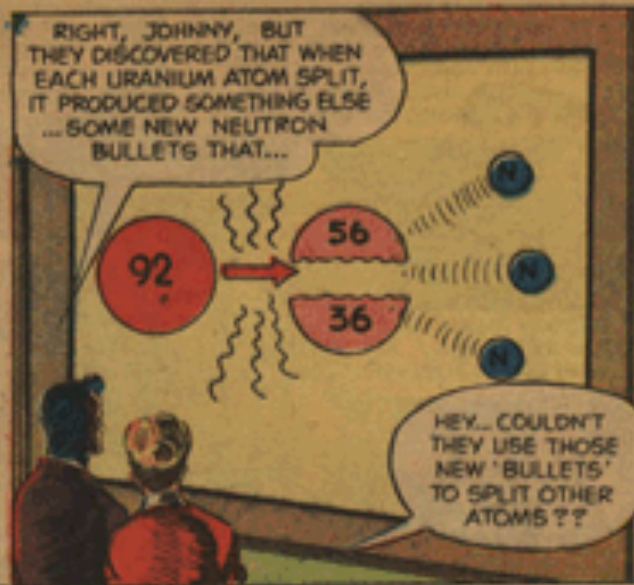
U235



I GET IT... YOU NEED U235 TO SPLIT... AND TO RELEASE ENERGY.

THAT'S RIGHT, JOHNNY... BUT WE STILL DIDN'T HAVE USABLE ENERGY. YOU SEE...





"YOU CAN HARDLY IMAGINE THE POWER OF THE SUDDEN RELEASE OF ENERGY IN UNCONTROLLED CHAIN REACTION..."



"WOW! SO THAT'S HOW THE ATOM BOMB WORKS!"

"YES, BUT AS RECENTLY AS 1940, IT SEEMED IMPOSSIBLE TO GET ENOUGH PURE U235 TO MAINTAIN A CHAIN REACTION. HERE'S WHY..."



"IT WAS ALMOST IMPOSSIBLE TO SEPARATE U235 FROM U238 BECAUSE THEY BOTH ARE THE SAME ELEMENT. BUT WE FINALLY FOUND A WAY TO DO IT ON A SMALL SCALE..."

"AT THIS RATE IT WILL TAKE US CENTURIES TO SEPARATE ENOUGH U235."

"THERE IS ONLY ONE OUTFIT BIG ENOUGH TO HANDLE THIS JOB."



"MR. PRESIDENT, PROFESSOR EINSTEIN ASKED THAT HIS LETTER BE DELIVERED TO YOU PERSONALLY."

"...PROBABLE THAT A NUCLEAR CHAIN REACTION CAN BE SET UP... VAST AMOUNTS OF POWER... GENERATED..."



"AND THE PRESIDENT OF THE UNITED STATES BROUGHT TOGETHER HISTORY'S LARGEST COMBINATION OF..."

"THE FABULOUS RESOURCES OF THE WORLD'S RICHEST NATION"

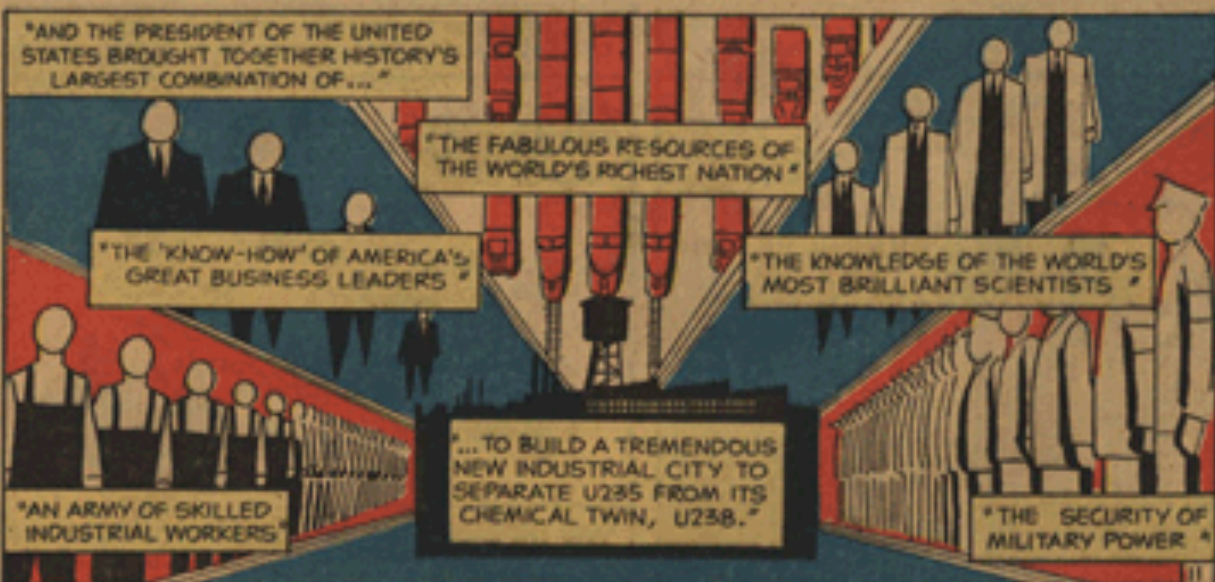
"THE 'KNOW-HOW' OF AMERICA'S GREAT BUSINESS LEADERS"

"THE KNOWLEDGE OF THE WORLD'S MOST BRILLIANT SCIENTISTS"

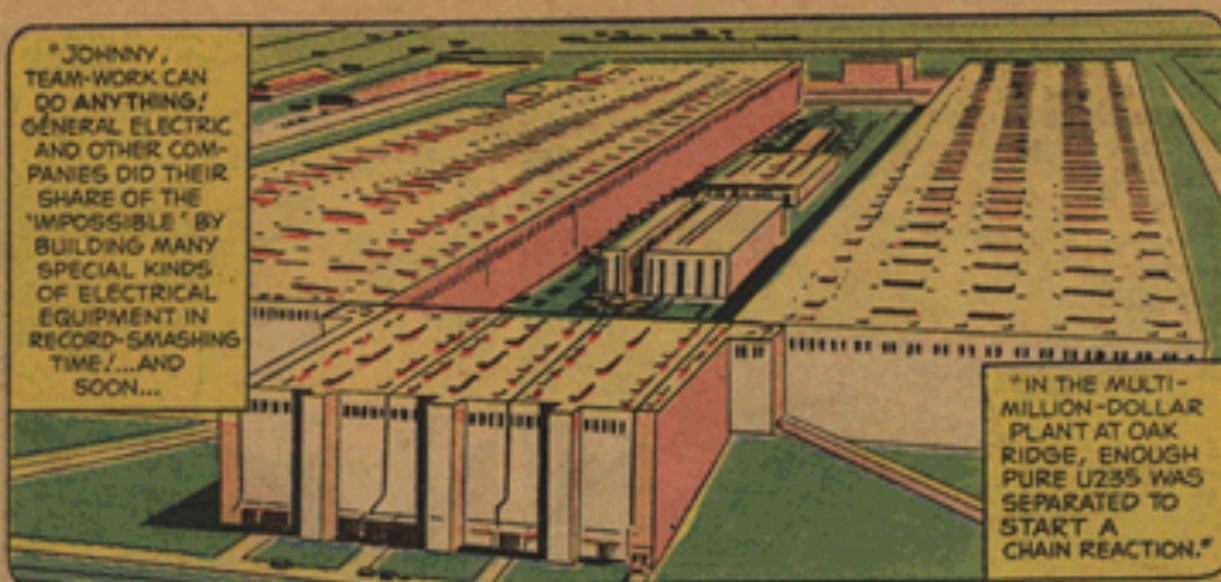
"AN ARMY OF SKILLED INDUSTRIAL WORKERS"

"... TO BUILD A TREMENDOUS NEW INDUSTRIAL CITY TO SEPARATE U235 FROM ITS CHEMICAL TWIN, U238."

"THE SECURITY OF MILITARY POWER"



"JOHNNY, TEAM-WORK CAN DO ANYTHING! GENERAL ELECTRIC AND OTHER COMPANIES DID THEIR SHARE OF THE 'IMPOSSIBLE' BY BUILDING MANY SPECIAL KINDS OF ELECTRICAL EQUIPMENT IN RECORD-SMASHING TIME!...AND SOON..."



"IN THE MULTI-MILLION-DOLLAR PLANT AT OAK RIDGE, ENOUGH PURE U235 WAS SEPARATED TO START A CHAIN REACTION."

GEE, ALL THAT JUST TO MAKE A BOMB."

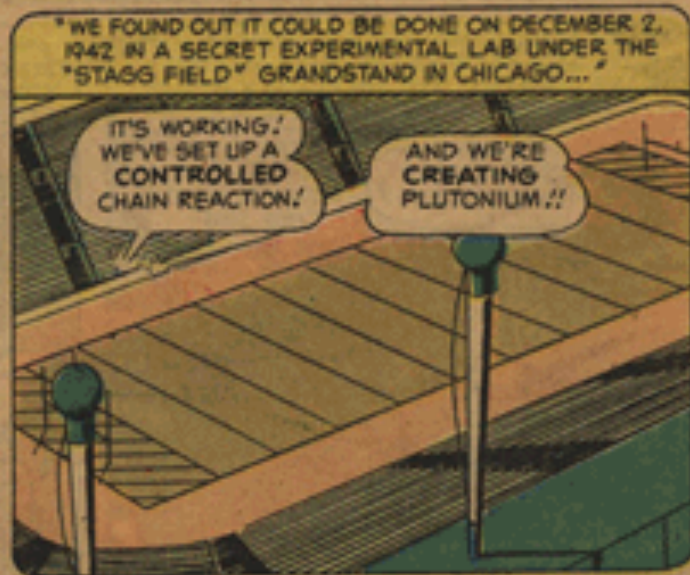
TO END THE WAR QUICKLY, NO EFFORT WAS TOO GREAT, JOHNNY...AND WE TRIED TO PRODUCE ANOTHER SOURCE OF ATOMIC POWER



"WE FOUND OUT IT COULD BE DONE ON DECEMBER 2, 1942 IN A SECRET EXPERIMENTAL LAB UNDER THE 'STAGG FIELD' GRANDSTAND IN CHICAGO..."

IT'S WORKING! WE'VE SET UP A CONTROLLED CHAIN REACTION!

AND WE'RE CREATING PLUTONIUM!!

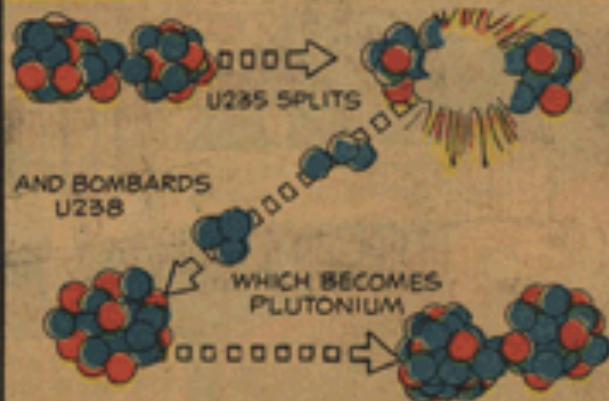


"PLUTONIUM," WHAT'S THAT?

IT'S A NEW, MAN-MADE ELEMENT, JOHNNY...MADE FROM THOSE PLENTIFUL U238 ATOMS WE HAD THOUGHT USELESS.

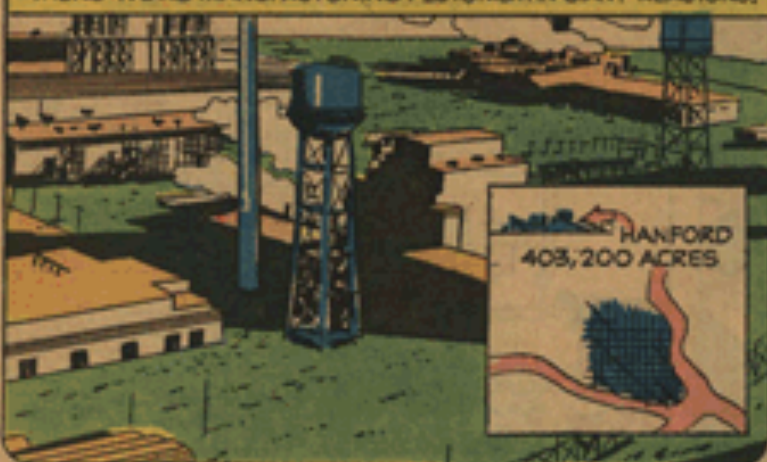


"IN A 'REACTOR' OF URANIUM, THE CHAIN-REACTION OF U235 CHANGES U238 ATOMS INTO 94 PLUTONIUM."



"AND THE EASIER-TO-SEPARATE PLUTONIUM CAN MAINTAIN CHAIN REACTION JUST LIKE U235."

"AND SO, AT HANFORD, WASHINGTON, UNCLE SAM BUILT A GREAT NEW KIND OF PLANT. IT'S NOW OPERATED BY GENERAL ELECTRIC FOR THE ATOMIC ENERGY COMMISSION... AND THERE WE'RE MANUFACTURING PLUTONIUM IN GIANT 'REACTORS';"



WHAT'S THAT 'REACTOR' YOU'RE TALKING ABOUT, ED?

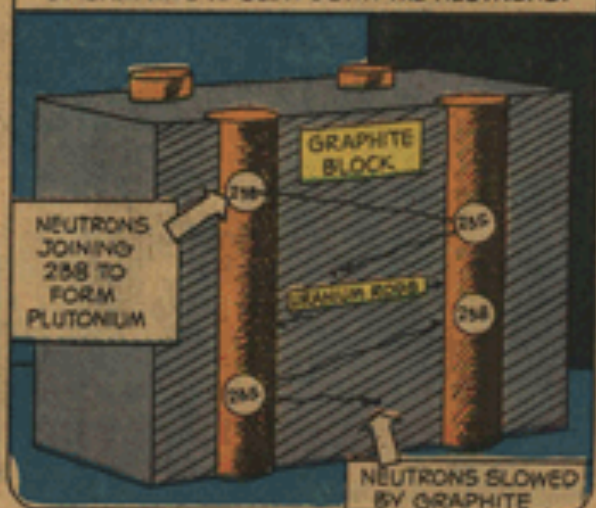
THEY'RE 'FACTORIES' WHERE WE CAN CONTROL A CHAIN REACTION OF SPLITTING ATOMS. LIKE THIS...



"NOTICE HOW THE WOODEN MATCH STICKS SLOW DOWN THE CHAIN REACTION OF THE MATCH-HEADS..."



"IN A 'REACTOR' URANIUM RODS ARE SEPARATED BY GRAPHITE TO SLOW DOWN THE NEUTRONS."



UH HUH... BUT, WOULDN'T THE 'REACTOR' FINALLY EXPLODE ANYWAY?

NO, BECAUSE... JUST AS THIS WET BLOTTER CAN PREVENT THE FIRE FROM SPREADING...



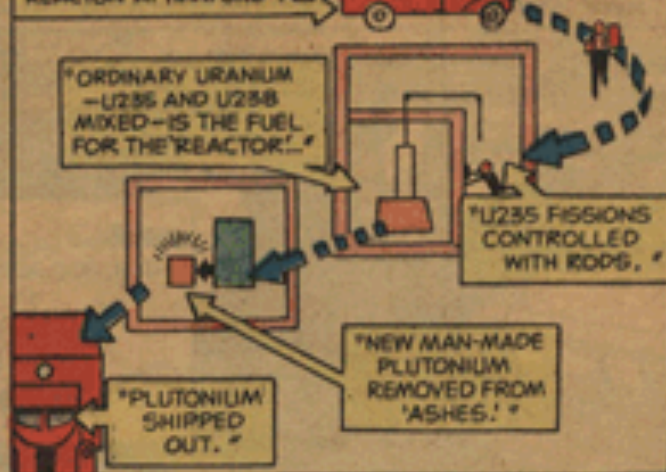
"...ADJUSTABLE CONTROL RODS IN THE 'REACTOR' ABSORB NEUTRON BULLETS... THE MORE 'BLOTTING' RODS THE LESS FISSIONS."



HERE, LET'S WORK THIS MODEL 'REACTOR'. THE GRAPHITE SLOWS THE RATE OF FISSION AND ADJUSTING THESE CONTROL RODS REGULATES THE AMOUNT OF FISSION.



"AND HERE'S HOW GENERAL ELECTRIC OPERATES THE 'REACTOR' AT HANFORD":



"IN BOTH LABORATORIES AND PRODUCTION PLANTS, SAFETY IS ASSURED IN MANY WAYS..."



AND, LOOK HERE, JOHNNY... GENERAL ELECTRIC'S MECHANICAL 'HANDS' - DESIGNED TO HANDLE RADIOACTIVE MATERIALS BY REMOTE CONTROL.

